Note on some Points in the Structure of the Gill of the Ceylon Pearl-Oyster. By W. A. Herdman, F.R.S., President.

[Read 3rd November, 1904.]

(Plate 27.)

In examining the structure of the gill in *Margaritifera vulgaris*, Schum., for the purposes of my Report on the Ceylon Pearl-Oyster Fisheries, I have come upon two little points which may be of sufficient interest to be put on record *.

The first of these is the presence of extensive ciliated junctions (1) in the median line between the inner gills of the two sides, and (2) laterally between each outer gill and the mantle-lobe.

In examining the living pearl-oyster the inner gills seem to be united in the middle line, and the outer gills seem to be joined to the mantle outside them. In dissecting a well-preserved specimen, where there has been no marked contraction or distortion, the same apparent continuity is seen. Concrescence of these originally separate parts seems to have taken place as in many other Pelecypoda, such as most of the Eulamellibranchia. On manipulating the gills, however, it is found that slight pressure with dissecting-needles is generally sufficient to force the parts asunder, and they are seen to separate with clean-cut broad edges or seams and leave no appearance of tearing. Figure (Pl. 27) 1 is a diagrammatic transverse section of both ctenidia (the four "gills"), and the darker lines at *M.c.j.* and *L.c.j.* show the junctions in question. Figure 2 is a dissection of the right ctenidium separated at *M.c.j.* from its fellow of the other side and at *L.c.j.* from the mantle, so as to show the broad seams.

Transverse sections (such as figure 3) through the gills and mantle show that the explanation of these adhesions, and yet ready separation, is that the seams in the case of both gills and mantle-lobes are covered with short stiff cilia which interlock to form very effective and extensive ciliated junctions. Figure 4 shows the median one between the upturned ends of the inner lamellæ of the inner gills. The gap in the centre is probably a post-mortem separation of the two epithelial layers. Figure 5 shows the lateral junction between the reflected or outer lamina

* They are briefly referred to in Part II. of the Report to the Ceylon Government (Royal Society, 1904).

of the outer gill (*g.f.*) and the inner surface of the mantle-lobe (*Pall.*). At these ciliated junctions the epithelial cells are cubical or low columnar with a distinct marginal band from which the very regular stiff cilia project (Pl. 27. figs. 4 a & 5 a).

It is interesting to note that in some, if not in all, specimens, at the extreme ventral end of the median ciliated junction between the two inner gills, the epithelial and connective tissues have united across the narrow passage (fig. 4, *org.*), and so true concrescence or continuous organic union has, at that point, replaced the ciliated junction.

In the Eulamellibranchia the ascending lamella of the outer gill is usually concrescent with the mantle, and the inner lamellæ of the inner gills are united in the middle line; but such junctions are quite exceptional in the Eleutherorhabda, and where they do occur there is an irregularity about their distribution, allied species showing very different conditions. Consequently it is interesting to find this new form of junction, which may be regarded as intermediate between perfect freedom and complete concrescence *. The presence of this ciliated form of junction, which allows of an easy separation of the opposed surfaces, may also account for the differences of opinion we find amongst authorities. Pelseneer gives as a character of the family to which the pearl-oysters belong that the branchiæ are joined to the mantle, and Ridewood says that in *Meleagrina vulgaris* and *M. margaritifera* there is no fusion with adjacent parts. My specimens, with their ciliated junctions, show the one or the other condition according to their state of preservation.

The second structural point I desire to record is the presence of somewhat extensive organic connections between the adjacent gill-filaments of a plica at the level of the ciliated discs.

Figure 7 shows the manner in which, as seen in a horizontal section across both ctenidia (four "gills," *o.g.* and *i.g.* on each side), the filaments are thrown into crests and troughs so as to form plicæ. In the trough between two plicæ lies a modified or

* Ridewood (Phil. Trans. B. vol. 195, p. 194) has described, in the case of *Anomia aculeata*, patches of interlocking cilia by means of which the lower edges of the two inner gills are held together, and the lower edges of the outer gills are joined to the mantle. The filaments in this case, however, are not reflected, so the relations of parts are not the same as those described above in the Ceylon Pearl-Oyster; but the small patches in *Anomia* may be an indication of the same tendency to form ciliated junctions between adjacent parts.

"principal" filament (figs. 6, 7, 8, *p.f.*). At certain levels (fig. 6) the ordinary filaments are kept in position by pad-like thickenings, the ciliated discs (*c.d.*) bearing short stiff cilia which interlock. Dr. Ridewood, in his recent admirable memoir "On the Structure of the Gills of the Lamellibranchia" (Phil. Trans. B. vol. 195, 1903), has figured in *Avicula argentea* the simultaneous presence of ciliated junctions and true organic union of the filaments; and in stating that no other instance occurred in the whole of his extensive investigation, adds (p. 155, footnote), "except perhaps in *Meleagrina vulgaris*, the specimen of which was not sufficiently well-preserved to enable one to determine the point." The latter species is the Ceylon Pearl-Oyster and the *Avicula* is a closely allied species; and I can entirely agree with all that Dr. Ridewood has been able to determine in regard to these forms. All I am able to do is to add a little detail, and even that point of structure was probably suspected by Dr. Ridewood, although his material was not apparently in a condition to show it. In his memoir (p. 213), after describing the condition in *Avicula argentea*, he says:—"Possibly a similar cellular connection obtains in *Meleagrina vulgaris*." I can now state definitely that it is in that species, as Dr. Ridewood thought might possibly be the case. In examining a series of sections through the plicæ of well-preserved gills, it is easy to find groups of 2, 3, 4, or 5 filaments joined by continuous organic union—the growth of connective tissue and epithelium having, in these interfilamentar spaces, replaced or supplemented the usual ciliated junctions. Thus the two forms of junction exist side by side or form a compound union, and all degrees of formation of a complete cellular connection may be found (see fig. 12). It is scarcely possible, after examining such conditions, to doubt that ciliated junctions have preceded the organic union. Figure 11 shows two filaments joined by the compound of ciliated disc and cellular connection, and fig. 12 shows the presence together in the one plica, at the same level, of ordinary ciliated junctions and various degrees of organic growth. Since these figures were drawn I have found a specimen where all the twelve filaments of a plica were united by complete organic union (Pl. 27. figs. 7 *c* and *d*). The concrescence is not always at the internal edges of the filaments, but may be about the middle of the former ciliated disc; and in one case I found two points of union between two neighbouring filaments leaving an ovate ciliated gap.

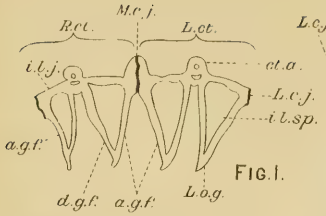


FIG. 1.

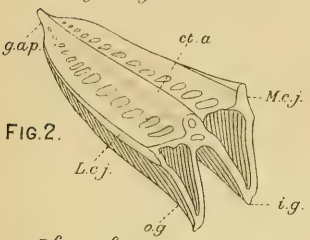


FIG. 2.

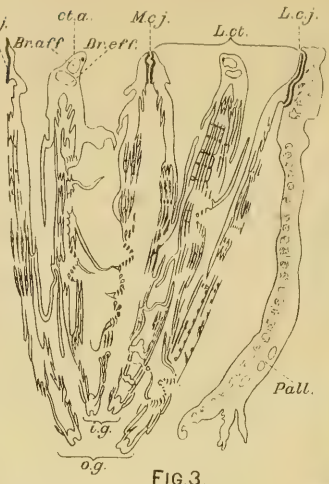


FIG. 3.

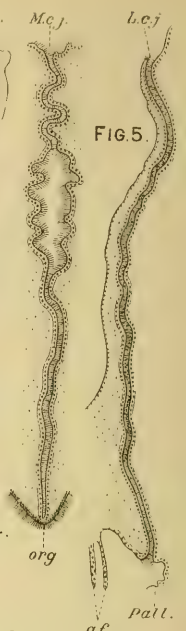


FIG. 4.

FIG. 5.

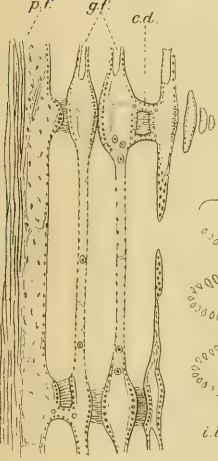
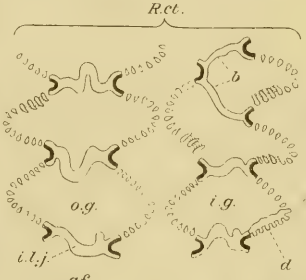


FIG. 6.


4a.


5a.



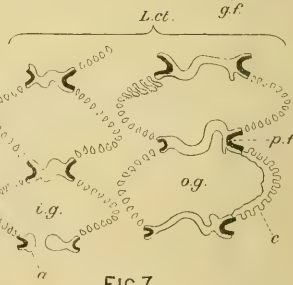


FIG. 7.

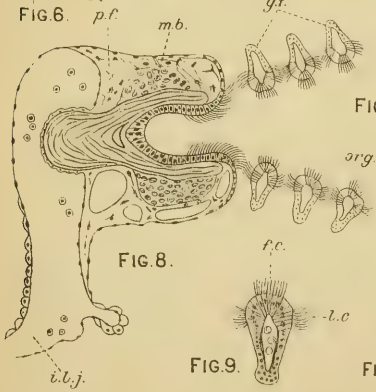


FIG. 8.

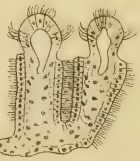


FIG. 11.

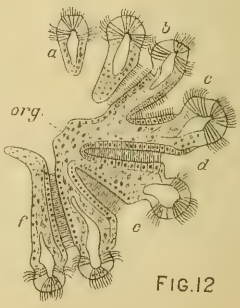


FIG. 12.

FIG. 9.

FIG. 10.

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GILL OF CEYLON PEARL OYSTER.

Organic interfilamentar junctions are characteristic of the Eulamellibranchia, and, as Ridewood has noted, "with one exception do not occur in the Eleutherorhabda." It is therefore of some interest to add the Ceylon Pearl-Oyster as another exception, and to find that in this character of the interfilamentar junctions, as well as in that taken from the connections of the gills with neighbouring parts, this member of the Eleutherorhabda shows an approach to the Eulamellibranchiate condition.

EXPLANATION OF PLATE 27.

Fig. 1. Diagrammatic transverse section through the two ctenidia of the Pearl-Oyster, to show the axes (*ct.a.*) and the position of the median (*M.c.j.*) and lateral (*L.c.j.*) ciliated junctions. × 2.

2. Dissection of left ctenidium showing the appearance of the median and lateral ciliated junctions. × 2.

3. Transverse section through left mantle-lobe and both ctenidia, to show the extent of the median and lateral ciliated junctions. × 15.

4. The median ciliated junction between the inner lamellæ of the inner gills: *org.*, slight organic connection. ×400. 4 a. Small part of the ciliated epithelium, enlarged.

5. The lateral ciliated junction between the outer lamella of the outer gill and the mantle-lobe (*Pall.*). ×400. 5 a. Small part of the ciliated epithelium, enlarged.

6. Longitudinal section along the gill-filaments, to show the ciliated discs (*c.d.*). × 50.

7. Horizontal section across the two ctenidia (four "gills," *o.g.* and *i.g.*). × 50.

8. Part of last more highly magnified to show the filaments in cross-section. × 400.

9. An ordinary gill-filament in transverse section. × 500.

10. Transverse section of a filament at the level of a ciliated disc (*c.d.*). × 500.

11. Section showing two filaments joined by organic union at the level of a ciliated disc. × 400.

12. Section showing a group of filaments joined by various combinations of organic union with ciliated discs. × 400.